IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	10/706,472
Appellant	:	Thomas James Batzinger et al.
Filed	:	November 10, 2003
Title		:ELECTROCHEMICAL MACHINING METHOD, TOOL ASSEMBLY, AND MONITORING METHOD
TC/A.U.	:	1742
Examiner	:	Nicolas A. Smith
Docket No.	:	RD 28303-1

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF PURSUANT TO 37 C.F.R. § 41.37

This Appeal Brief is being filed in furtherance to the Notice of Appeal submitted on March 20, 2007.

The Commissioner is authorized to charge the requisite fee of $500.00, and any additional fees, which may be necessary to advance prosecution of the present application, to Account No. 07-0868.

1. REAL PARTY IN INTEREST

The real party in interest is General Electric Company, the Assignee of the above-referenced application by virtue of the Assignment to General Electric Company by Thomas James Batzinger, Robert John Filkins, Bin Wei, Wei Li, Carl Stephen Lester, Thomas Rogenski, and Michael Scott Lamphere. Accordingly, General Electric Company will be directly affected by the Board's decision in the pending appeal.

2. RELATED APPEALS AND INTERFERENCES

Appellant is unaware of any other appeals or interferences related to this Appeal. The undersigned is Appellant's legal representative in this Appeal.

3. STATUS OF CLAIMS

Claims 22-31 are cancelled in this application. Claims 1-21 are currently pending, are currently under final rejection and, thus, are the subject of this Appeal.

4. STATUS OF AMENDMENTS

No Amendments were filed subsequent to the close of prosecution for this Application.

5. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates generally to the field of electrochemical machining and, more particularly, to an improved method for monitoring interelectrode gap size and workpiece thickness during electrochemical machining operations. (See, Application page 1, paragraph 1.)

The Application contains three pending independent claims. Claim 1 is directed to a method of monitoring machining in an electrochemical machining tool assembly, Claim 12 is directed to a method of monitoring machining in a pulsed electrochemical machining tool assembly, and Claim 15 is directed to an electrochemical machining method for machining a workpiece. The subject matter of these independent claims is summarized below.

Discussions of the recited features of Claim 1 can be found in at least the following cited locations of the specification. By way of example, Figure 1 illustrates an electrochemical

machining tool assembly embodiment of the invention, and Figure 3 is an exemplary ultrasonic measurement timing diagram for the electrochemical machining tool assembly of Figure 1. Claim 1 is directed to a method of monitoring machining in an electrochemical machining tool assembly 10 having at least one electrode 26 arranged across a gap 34 from a workpiece 12. (See, Application, page 5, paragraph 17 and Figure 1.) The electrode 26 is energized by application of a potential difference ΔV between the electrode 26 and the workpiece 12. (See, Application, page 5, paragraph 17.) The method includes exciting at least one ultrasonic sensor 42 to direct an ultrasonic wave toward a surface 102 of the electrode 26, receiving a reflected ultrasonic wave from the surface 102 of the electrode 26 using the ultrasonic sensor 42. The reflected ultrasonic wave comprises a number of reflected waves from the surface 102 of the electrode 26 and from a surface 104 of the workpiece 12. (See, Application, page 9-10, paragraph 25.) The method further includes synchronizing the excitation of the ultrasonic sensor 42 to a machining cycle of the electrochemical machining tool, where the synchronizing comprises delaying the excitation of the ultrasonic sensor 42 a dwell time T_d after a reduction of the potential difference ΔV across the electrode 26 and the workpiece 12 occurs, such that the exciting and receiving are performed during a number of machining off-times. (See, Application, page 7, paragraph 20 and Figure 3.)

Discussions of the recited features of Claim 12 can be found in at least the following cited locations of the specification. Claim 12 is directed to a method of monitoring machining in a pulsed electrochemical machining tool assembly 10 having at least one electrode 26 arranged across a gap 34 from a workpiece 12. (See, Application, page 10, paragraph 27; page 11-12, paragraph 30; and Figure 1.) The electrode 26 is periodically energized by application of a number of pulses. (See, Application, page 10, paragraph 27; and pages 11-12, paragraph 30.) The method includes exciting at least one ultrasonic sensor 42 to direct an ultrasonic wave toward a surface 102 of the electrode 26 and receiving a reflected ultrasonic wave from the surface 102 of the electrode 26 using the ultrasonic sensor 42. The reflected ultrasonic wave comprises a number of reflected waves from the surface 102 of the electrode 26 and from the surface 104 of the workpiece 12. The method further includes synchronizing the excitation of the ultrasonic sensor 42 to a machining cycle of the electrochemical machining tool, where the

synchronizing comprises delaying the excitation of the ultrasonic sensor 42 a dwell time T_d after a transition from a pulse-on state to a pulse-off state, such that the exciting and receiving are performed during a number of machining off-times. (See, Application, page 7, paragraph 20; page 10, paragraph 27; pages 11-12, paragraph 30; and Figure 3.)

Discussions of the recited features of Claim 15 can be found in at least the following cited locations of the specification. Claim 15 is directed to an electrochemical machining method for machining a workpiece 12 that includes energizing at least one electrode 26 positioned in proximity to the workpiece 12, where the electrode 26 and the workpiece 12 are separated by a gap 34. (See, Application, page 12, paragraph 31; and Figure 1.) The electrochemical machining method further includes flowing an electrolyte through the gap 34, flushing the electrolyte from the gap 34 (see, Application, page 12, paragraph 31; and Figure 2), feeding the at least one electrode 26 toward the workpiece 12 and monitoring at least one of the gap 34 and the workpiece 12 using at least one ultrasonic sensor 42. (See, Application, page 12, paragraph 31.) The monitoring comprises exciting the ultrasonic sensor 42 to direct an ultrasonic wave toward a surface of the electrode 26, and receiving a reflected ultrasonic wave from the surface 102 of the electrode 26 using the ultrasonic sensor 42, where the reflected ultrasonic wave comprises a number of reflected waves from the surface 102 of the electrode 26 and from the surface 104 of the workpiece 12. The monitoring further includes, synchronizing the excitation of the ultrasonic sensor 42 to a machining cycle of the electrochemical machining tool, where the synchronizing comprises delaying the excitation of the ultrasonic sensor 42 a dwell time T_d after a reduction of the potential difference ΔV across the electrode 26 and the workpiece 12 occurs, such that the exciting and receiving are performed during a number of machining off-times. (See, Application, page 12-13, paragraph 31; and Figure 3.)

By way of example, an exemplary ultrasonic measurement timing diagram is illustrated in Figure 3. For the method of monitoring machining in a pulsed electrochemical machining tool assembly 10, the electrode 26 is energized by a periodic application of a potential difference ΔV between the electrode and the workpiece 12 during a number of pulse-on periods, as discussed above. For this embodiment, the excitation of the ultrasonic sensor 42 is delayed for the dwell

time T_d after a transition from the pulse-on state to a pulse-off state, as indicated in FIG. 3. (See, Application, page 8-9, paragraph 23.) For another embodiment, the electrochemical machining tool assembly 10 is a continuous electrochemical machining tool assembly, for example employing a DC power supply 40. For this latter embodiment, the monitoring method further includes repeatedly reducing the potential difference ΔV across the electrode 26 and the workpiece 12 to generate a series of measurement periods Δt_M, as is also shown in FIG. 3. For this latter continuous embodiment, the excitation of the ultrasonic sensor 42 is delayed a dwell time T_d after a start of one of the measurement periods Δt_M, as indicated in FIG. 3. (See, Application, page 9, paragraph 23.)

Benefits of the invention, as described in the specification, include improving ultrasonic monitoring of electrochemical machining (ECM) operations without compromising electrochemical machining quality. (See, Application, page 3, paragraph 7.) Specifically, by delaying the excitation of the ultrasonic sensor 42 by a dwell time T_d, excitation of the ultrasonic sensor 42 may be synchronized to the machining cycle, such that the ultrasonic sensor is used during machining off-times, that is during portions of the machining cycle in which the machining potential across the electrode 26 and workpiece 12 is either off or reduced. This helps clear the bubbles and reduce electromagnetic interference with the measurement. (See, Application, page 7, paragraph 20.) Reducing the ECM voltage may impair ECM machining quality. (See, Application, page 7, paragraph 21.) Accordingly, it is desirable to complete the voltage adjustment in a short time period, to avoid compromising ECM machining quality. Under typical ECM conditions, the gas bubbles are flushed away in less than about fifteen milliseconds (15 ms). Moreover, the ultrasonic measurement itself takes only a short time, typically on the order of less than about fifty microseconds (50 μs). Under these conditions, the ultrasonic measurement cycle, which includes the above-noted delay for the electrolyte to wash away the gas bubbles, as well as the actual ultrasonic measurement time window, may be relatively short, for example less than about twenty milliseconds (20 ms), during which time the voltage level is reduced, such that the ultrasonic signals are not significantly attenuated. Beneficially, because this period is relatively short, ECM machining quality is not compromised.

Moreover, because of the delay, adequate flushing of the bubbles occurs, permitting relatively clean ultrasonic measurements. (See, Application, pages 7-8, paragraph 21.)

This is a clear difference and distinction from the prior art, as discussed below.

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

First Ground of Rejection for Review on Appeal:

Appellant respectfully urges the Board to review and reverse the Examiner's first ground of rejection in which Claims 1, 2, 8, 10-12, 15, 18 and 20 were rejected under 35 USC § 102(b) over U.S. Patent No. 6,355,156 (Li).

Second Ground of Rejection for Review on Appeal:

Appellant respectfully urges the Board to review and reverse the Examiner's second ground of rejection in which Claims 3, 9, 19 and 21 were rejected under 35 USC § 103(a) over Li.

Third Ground of Rejection for Review on Appeal:

Appellant respectfully urges the Board to review and reverse the Examiner's third ground of rejection in which Claims 3-7, 13, 14, 16, 17 and 19 were rejected under 35 USC § 103(a) over Li, in view of US 2003/0079989 (Klocke).

7. ARGUMENT

As discussed in detail below, Claims 1-21 define allowable subject matter over the cited art. Accordingly, Appellant respectfully requests full and favorable consideration by the Board.

A. Ground of Rejection No. 1:

The Examiner rejected Claims 1, 2, 8, 10-12, 15, 18 and 20 under 35 USC § 102(b) over U.S. Patent No. 6,355,156 (Li).

1. Judicial precedent has clearly established a legal standard for a *prima facie* anticipation rejection.

Anticipation under Section 102 can be found only if a single reference shows exactly what is claimed. *Titanium Metals Corp. v. Banner*, 227 U.S.P.Q. 773 (Fed. Cir. 1985). However, "[i]f the prior art reference does not expressly set forth a particular element of the claim, that reference may still anticipate if that element is 'inherent' in its disclosure. To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill.' ... 'Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.' " In re Robertson, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999). Accordingly, Appellant need only point to a single element not found, either expressly or inherently, in the cited reference to demonstrate that the cited reference fails to anticipate the claimed subject matter.

2. Claims 1, 2, 8, 10-12, 15, 18 and 20 are not anticipated by Li.

Claim 1 is directed to a method of monitoring machining in an electrochemical machining tool and includes, in part, *synchronizing the excitation of the ultrasonic sensor to a machining cycle* of the electrochemical machining tool. *The synchronizing comprises delaying the excitation of the ultrasonic sensor* a dwell time T_d after a reduction of the potential difference ΔV across the electrode and the workpiece occurs, such that the exciting and receiving are performed during a number of machining off-times.

As noted on page 2 of the Office Action dated December 22, 2006, "Li et al. does not specifically disclose an active step of synchronizing the sensor to a machining cycle of the ECM tool." Instead, the Examiner contends that "synchronizing is inherent in operation of the ultrasonic sensor with the ECM tool in that excitation of the ultrasonic tool is suggested during the off time interval of pulsed electrochemical machining (col. 5, lines 40-45)."

Appellant respectfully submits that synchronizing is not inherent to Li and that Li discloses a different approach. Col. 5, lines 40-45 of Li teach that the DC power supply may be turned off for a brief period of time, such as for the time interval used in pulsed electrochemical machining, so as to minimize the generation of gas bubbles for more accurate measurements. Thus, in contrast to the claimed step of *synchronizing the excitation of the sensor* to a machining cycle of the ECM tool, Li suggests *turning the DC power supply off* for a brief period of time. Not only is the synchronizing recitation of Claim 1 not inherent to Li, the portion of Li cited by the Examiner (col. 5, lines 40-45) teaches another approach, namely turning the DC power off for a brief period of time. The approach of Li is further clarified in Claims 7 and 8. Adjusting the ECM voltage as suggested in the cited portion of Li could potentially compromise ECM machining quality. In contrast, by synchronizing the excitation of the ultrasonic sensor to the machining cycle of the electrochemical machining tool, improved ultrasonic monitoring is achieved without compromising electrochemical machining quality.

The Examiner's inherency argument is further flawed in that Li does not disclose means for *delaying the excitation of the ultrasonic sensor* a dwell time T_d after a reduction of the potential difference ΔV across the electrode and the workpiece occurs, as recited by Claim 1. In contrast, the electrochemical tool assembly of the present application includes a delay generator 110, as shown for example in Figures 1, 3 and 4. As Li neither suggests performing the recited step nor discloses means for performing the recited step of synchronizing the excitation of the ultrasonic sensor to a machining cycle of the electrochemical machining tool, where the synchronizing comprises delaying the excitation of the ultrasonic sensor a dwell time T_d after a reduction of the potential difference ΔV across the electrode and the workpiece occurs, Appellant respectfully submits that this recited step is not inherently disclosed by Li.

The Examiner further argues that "[m]ultiple measurements of the ultrasonic sensor would be inherently made in that the ultrasonic sensor is used in a method of ECM monitoring, and thus requiring multiple thickness measurements (claim 1, abstract)." Regardless, this does not teach or suggest the claimed recitation of *synchronizing the excitation of the sensor* to a machining cycle of the ECM tool, *where the synchronizing comprises delaying the excitation of*

the ultrasonic sensor a dwell time T_d after a reduction of the potential difference ΔV across the electrode and the workpiece occurs. Rather, one skilled in the art would have turned the DC power supply off for a brief period of time, each time a measurement was to be made, as suggested in Col. 5, lines 40-45 and in Claims 7 (disconnecting the tool and the workpiece from the source of electrical power) and 8 (reducing the voltage).

On page 6 of the office action dated December 22, 2007, the Examiner argues that a dwell time would be inherent to the method of Li. Regardless, Li does not teach or suggest synchronizing the excitation of the sensor to a machining cycle of the ECM tool, where the synchronizing comprises delaying the excitation of the ultrasonic sensor a dwell time T_d, neither recognizing a need for synchronization nor disclosing means for accomplishing the synchronization. On the contrary in Col. 5, lines 45-50 and in Claims 7 and 8, Li teaches turning the DC power off (or reducing voltage, Claim 8) when calculating measurement. Appellant respectfully submits that the Examiner's inherency arguments ignore the approach disclosed in Li at Col. 5, lines 45-50 and in Claims 7 and 8.

Thus, Appellant respectfully submits that the cited art does not teach or suggest all of the claim limitations of Claim 1. Claims 2, 8, 10 and 11 depend from Claim 1. Accordingly, a *prima facie* case of anticipation has not been established for Claims 1, 2, 8, 10 and 11, and Appellant requests that the Board overturn the rejection and allow Claims 1, 2, 8, 10 and 11.

Turning to Claim 12 and 15, Appellant respectfully submits that analogous arguments apply to Claims 12 and 15 and that that the cited art does not teach or suggest all of the claim limitations of Claims 12 and 15. Claims 18 and 20 depend from Claim 15. In view of the foregoing deficiencies in the teachings of the cited art, a *prima facie* case of anticipation has not been established for Claims 12, 15, 18 and 20, and Appellant requests that the Board overturn the rejection and allow Claims 12, 15, 18 and 20.

B. Ground of Rejection No. 2:

The Examiner rejected Claims 3, 9, 19 and 21 under 35 USC § 103(a) as being unpatentable over Li.

1. Legal basis required to establish a *prima facie* case of obviousness.

The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (B.P.A.I. 1979). Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention absent some teaching or suggestion supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 U.S.P.Q. 929, 933 (Fed. Cir. 1984). Accordingly, to establish a *prima facie* case, the Examiner must not only show that the combination includes all of the claimed elements, but also a convincing line of reason as to why one of ordinary skill in the art would have found the claimed invention to have been obvious in light of the teachings of the references. *Ex parte Clapp*, 227 U.S.P.Q. 972 (B.P.A.I. 1985). When prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988).

2. Claims 3, 9, 19 and 21 define allowable subject matter over Li.

a. *Claim 3*:

Claim 3 depends from Claim 1 and further recites that the electrochemical machining tool assembly is a continuous electrochemical machining tool assembly, and that the method further includes repeatedly reducing the potential difference ΔV across the electrode and the workpiece to generate a series of measurement periods Δt_M, wherein the synchronizing comprises *delaying*

the excitation of the ultrasonic sensor a dwell time T_d after a start of one of the measurement periods Δt_M.

The Examiner asserts that the synchronization of Claim 3 is inherently disclosed in Li. However, as discussed above in Section 7(A), Li does not inherently disclose the synchronization of Claim 3. In contrast to the claimed step of *delaying the excitation of the ultrasonic sensor*, Li suggests *turning the DC power supply off* for a brief period of time.

Further, Li does not disclose means for *delaying the excitation of the ultrasonic sensor* a dwell time T_d after a start of one of the measurement periods Δt_M, as recited by Claim 3. In contrast, the electrochemical tool assembly of the present application includes a delay generator 110, as shown for example in Figures 1, 3 and 4. As Li neither suggests performing the recited step nor discloses means for performing the recited step of synchronizing the excitation of the ultrasonic sensor to a machining cycle of the electrochemical machining tool, where the synchronizing comprises delaying the excitation of the ultrasonic sensor a dwell time T_d after a start of one of the measurement periods Δt_M, Appellant respectfully submits that this recited step is not inherently disclosed by Li. In view of the foregoing deficiencies in the teachings of the prior art, the cited art cannot establish a *prima facie* case of obviousness of Claim 3. Accordingly, Claim 3 is believed to be patentable over the cited art.

b. *Claim 9*:

Claim 9 depends from Claim 8, which depends from Claim 1, and further recites that the exciting step includes exciting a first ultrasonic sensor to direct an ultrasonic wave toward a surface of one of the electrodes and exciting a second ultrasonic sensor to direct an ultrasonic wave toward a surface of another of the electrodes. Claim 9 further recites that the receiving step comprises receiving respective reflected ultrasonic waves from the surface of each of the respective electrodes using the respective ultrasonic sensors. Claim 9 also recites that the delaying step comprises *delaying the excitation of a first one of the ultrasonic sensors* the dwell time T_d after a reduction of the potential difference ΔV across the electrodes and the workpiece

occurs and *delaying the excitation of the other of the ultrasonic sensors the dwell time T_d plus an offset δ after a reduction of the potential difference ΔV across the electrodes and the workpiece occurs, where the offset δ is at least the time required to attenuate the ultrasonic wave from the first one of the ultrasonic sensors.*

Appellant respectfully submits that Claim 9 is patentably distinguishable over Li for the reasons discussed above in Section 7(A) with respect to Claim 1. In addition, there is no indication, other than in Appellant's disclosure, of the combination recited in Claim 9. On page 4 of the final office action dated December 22, 2006, the Examiner agrees that Li does not disclose the additional recitations of Claim 9. However, the Examiner argues that it would have been obvious to modify Li to practice the additional recitations of Claim 9. To the extent that the Examiner is arguing that it would have been obvious to try the claimed combination, Appellant respectfully submits that "obvious to try" is not the standard that needs to be met for a *prima facie* case of obviousness. Rather, there must be a reasonable expectation of success by one of ordinary skill in the art. That has not been demonstrated here. In view of the foregoing deficiencies in the teachings of the cited art, the cited art cannot establish a *prima facie* case of obviousness for Claim 9. Accordingly, Claim 9 is believed to be patentable over the cited art.

c. *Claim 19*:

Claim 19 depends from Claim 15, which recites synchronizing the excitation of the ultrasonic sensor to a machining cycle of the electrochemical machining tool, the synchronizing comprising *delaying the excitation of the ultrasonic sensor* a dwell time T_d after a reduction of the potential difference ΔV across the electrode and the workpiece occurs, such that the exciting and receiving are performed during a plurality of machining off-times. Thus, Appellant respectfully submits that the cited art does not teach or suggest all of the claim limitations of Claim 19 for at least reasons analogous to those presented above in Section 7(A) with respect to Claim 1. Accordingly, Appellant respectfully submits that a prima facie case of obviousness has not been established for Claim 19. Accordingly, Claim 19 is believed to be patentable over the cited art.

d. *Claim 21*:

Claim 21 depends from Claim 15 and further recites controlling at least one of the energizing and the feeding in response to the monitoring data. Claim 21 is patentably distinguishable over Li for reasons analogous to those discussed above in Section 7(A) with respect to Claim 1. Further, there is no indication, other than in Appellant's disclosure, of the combination recited in Claim 21, and it appears that the Examiner has not addressed the additional recitations of Claim 21. In particular, Section 11 on page 4 of the final office does not address the additional recitation of Claim 21. In view of the foregoing deficiencies in the teachings of the cited art, the cited art cannot establish a *prima facie* case of obviousness for Claim 21. Accordingly, Claims 3, 9, 19 and 21 are believed to be patentable over the cited art. In view of the above, Appellant requests that the Board overturn the rejection and allow Claims 3, 9, 19 and 21.

C. Ground of Rejection No. 3:

Claims 3-7, 13, 14, 16, 17 and 19 were rejected under 35 USC § 103(a) over Li, in view of US 2003/0079989 (Klocke).

1. *Claim 3*:

Claim 3 depends from amended Claim 1. Klocke has not been cited against Claim 3. In view of the deficiencies of Li discussed above, the cited art cannot establish a *prima facie* case of obviousness for Claim 3. Accordingly, claim 3 is believed to be patentable over the cited art.

2. *Claim 4*:

Claim 4 depends from Claim 1 and further recites that the dwell time T_d is in a range of about seven milliseconds (7 ms) to about 15 milliseconds (15 ms). Klocke does not supply the deficiencies of Li discussed above with respect to Claim 1. Nor does Klocke supply the additional recitations of dependent Claim 4. The Examiner contends that paragraphs 76-77 of

Klocke teach that bubble minimization is a results effective variable and further that bubbles have an inherent time to leave the surface of a workpiece. In doing so, the Examiner appears to ignore the actual teachings of Klocke, which suggest *a list of variables* to produce relatively void-free photoresist films (for example agitation of the bath and vibration of the workpiece), none of which at all suggests a dwell time, let alone the recited dwell time. To the extent that the Examiner is arguing that it would have been obvious to try the claimed combination, Appellant respectfully submits that "obvious to try" is not the standard that needs to be met for a *prima facie* case of obviousness. Rather, there must be a reasonable expectation of success by one of ordinary skill in the art. That has not been demonstrated here. Accordingly, Appellant respectfully submits that Klocke does not teach or suggest the additional recitation of Claim 4. Nor does Klocke supply the above-discussed deficiencies of Li. In view of the deficiencies of the teachings of the prior art, the references cannot establish a *prima facie* case of obviousness for Claim 4. Accordingly, Claim 4 is believed to be patentable over the cited combination.

3. *Claims 5-7*:

Claims 5-7 depend from Claim 1. As discussed above, Li does not teach or suggest synchronizing the excitation of the ultrasonic sensor to a machining cycle of the electrochemical machining tool, as recited by amended Claim 1. Klocke does not supply this recitation of Claim 1. In view of the deficiencies of the teachings of the prior art, the references cannot establish a *prima facie* case of obviousness for Claims 5-7. Accordingly, Claims 5-7 are believed to be patentable over the cited combination.

4. *Claims 13 and 14*:

Claims 13 and 14 depend from Claim 12. Klocke does not supply the above-discussed deficiencies of Li with respect to Claim 12. Further, Appellant respectfully submits that Klocke fails to teach the additional recitation of Claim 14 for the reasons discussed above with reference to Claim 4. In view of the deficiencies of the teachings of the prior art, the references cannot

establish a *prima facie* case of obviousness for Claims 13 and 14. Accordingly, Claims 13 and 14 are believed to be patentable over the cited combination.

5. *Claims 16, 17 and 19*:

Claims 16, 17 and 19 depend from Claim 15. Klocke does not supply the above-discussed deficiencies of Li with respect to Claim 15. Further, Appellant respectfully submits that Klocke fails to teach the additional recitation of Claim 17 for the reasons discussed above with reference to Claim 4. In view of the deficiencies of the teachings of the prior art, the references cannot establish a *prima facie* case of obviousness for Claims 16, 17 and 19. Accordingly, Claims 16, 17 and 19 are believed to be patentable over the cited combination. In view of the above, Appellant requests that the Board overturn the rejection and allow Claims 3-7, 13, 14, 16, 17 and 19.

8. Conclusion

Appellant respectfully submits that all pending claims are in condition for allowance. However, if the Examiner or Board wishes to resolve any other issues by way of a telephone conference, the Examiner or Board is kindly invited to contact the undersigned legal representative at the telephone number indicated below.

Respectfully submitted,

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9. APPENDIX OF CLAIMS ON APPEAL

Listing of Claims:

1. A method of monitoring machining in an electrochemical machining tool assembly having at least one electrode arranged across a gap from a workpiece, the electrode being energized by application of a potential difference ΔV between the electrode and the workpiece, said method comprising:

exciting at least one ultrasonic sensor to direct an ultrasonic wave toward a surface of the electrode;

receiving a reflected ultrasonic wave from the surface of the electrode using the ultrasonic sensor, the reflected ultrasonic wave comprising a plurality of reflected waves from the surface of the electrode and from a surface of the workpiece; and

synchronizing the excitation of the ultrasonic sensor to a machining cycle of the electrochemical machining tool, the synchronizing comprising delaying the excitation of the ultrasonic sensor a dwell time T_d after a reduction of the potential difference ΔV across the electrode and the workpiece occurs, such that the exciting and receiving are performed during a plurality of machining off-times.

2. The method of Claim 1, wherein the electrochemical machining tool assembly is a pulsed electrochemical machining tool assembly, and wherein the electrode is energized by a periodic application of the potential difference ΔV between the electrode and the workpiece during a plurality of pulse-on periods, and wherein the delaying comprises delaying the excitation of the ultrasonic sensor the dwell time T_d after a transition from the pulse-on state to a pulse-off state.

3. The method of Claim 1, wherein the electrochemical machining tool assembly is a continuous electrochemical machining tool assembly, said method further comprising:

repeatedly reducing the potential difference ΔV across the electrode and the workpiece to generate a series of measurement periods Δt_M,

wherein the synchronizing comprises delaying the excitation of the ultrasonic sensor a dwell time T_d after a start of one of the measurement periods Δt_M.

4. The method of Claim 1, wherein the dwell time T_d is in a range of about seven milliseconds (7 ms) to about 15 milliseconds (15 ms).

5. The method of Claim 1, further comprising adjusting the dwell time T_d.

6. The method of Claim 5, wherein the adjusting comprises decreasing the dwell time T_d.

7. The method of Claim 5, wherein the adjusting comprises increasing the dwell time T_d.

8. The method of Claim 1, wherein the electrochemical machining tool assembly has at least two electrodes, each of the electrodes being arranged across a respective gap from the workpiece.

9. The method of Claim 8, wherein the exciting comprises exciting a first ultrasonic sensor to direct an ultrasonic wave toward a surface of one of the electrodes and exciting a second ultrasonic sensor to direct an ultrasonic wave toward a surface of another of the electrodes,

wherein the receiving comprises receiving respective reflected ultrasonic waves from the surface of each of the respective electrodes using the respective ultrasonic sensors, and

wherein the delaying comprises delaying the excitation of a first one of the ultrasonic sensors the dwell time T_d after a reduction of the potential difference ΔV across the electrodes and the workpiece occurs and delaying the excitation of the other of the ultrasonic sensors the dwell time T_d plus an offset δ after a reduction of the potential difference ΔV across the electrodes and the workpiece occurs, where the offset δ is at least the time required to attenuate the ultrasonic wave from the first one of the ultrasonic sensors.

10. The method of Claim 1, further comprising analyzing the reflected ultrasonic wave to determine at least one of (a) a size of the gap between the electrode and the workpiece and (b) a thickness of the workpiece.

11. The method of Claim 1, wherein the ultrasonic sensor comprises an ultrasonic transducer.

12. A method of monitoring machining in a pulsed electrochemical machining tool assembly having at least one electrode arranged across a gap from a workpiece, the electrode being periodically energized by application of a plurality of pulses, said method comprising:

exciting at least one ultrasonic sensor to direct an ultrasonic wave toward a surface of the electrode;

receiving a reflected ultrasonic wave from the surface of the electrode using the ultrasonic sensor, the reflected ultrasonic wave comprising a plurality of reflected waves from the surface of the electrode and from the surface of the workpiece; and

synchronizing the excitation of the ultrasonic sensor to a machining cycle of the electrochemical machining tool, the synchronizing comprising delaying the excitation of the

ultrasonic sensor a dwell time T_d after a transition from a pulse-on state to a pulse-off state, such that the exciting and receiving are performed during a plurality of machining off-times.

13. The method of Claim 12, further comprising adjusting the dwell time T_d.

14. The method of Claim 12, wherein the dwell time T_d is in a range of about seven milliseconds (7 ms) to about 15 milliseconds (15 ms).

15. An electrochemical machining method for machining a workpiece comprising:

energizing at least one electrode positioned in proximity to the workpiece, the electrode and the workpiece being separated by a gap;

flowing an electrolyte through the gap;

flushing the electrolyte from the gap;

feeding the at least one electrode toward the workpiece; and

monitoring at least one of the gap and the workpiece using at least one ultrasonic sensor, the monitoring comprising:

exciting the ultrasonic sensor to direct an ultrasonic wave toward a surface of the electrode,

receiving a reflected ultrasonic wave from the surface of the electrode using the ultrasonic sensor, the reflected ultrasonic wave comprising a plurality of reflected waves from the surface of the electrode and from the surface of the workpiece, and

synchronizing the excitation of the ultrasonic sensor to a machining cycle of the electrochemical machining tool, the synchronizing comprising delaying the excitation of the

ultrasonic sensor a dwell time T_d after a reduction of the potential difference ΔV across the electrode and the workpiece occurs, such that the exciting and receiving are performed during a plurality of machining off-times.

16. The method of Claim 15, wherein the monitoring further comprises adjusting the dwell time T_d.

17. The method of Claim 15, wherein the dwell time T_d is in a range of about seven milliseconds (7 ms) to about 15 milliseconds (15 ms).

18. The method of Claim 15, wherein the electrochemical machining tool assembly is a pulsed electrochemical machining tool assembly, and wherein the energizing comprises a periodic application of the potential difference ΔV between the electrode and the workpiece during a plurality of pulse-on periods, and wherein the delaying comprises delaying the excitation of the ultrasonic sensor the dwell time T_d after a transition from the pulse-on state to a pulse-off state.

19. The method of Claim 15, wherein the electrochemical machining tool assembly is a continuous electrochemical machining tool assembly, said method further comprising:

repeatedly reducing the potential difference ΔV across the electrode and the workpiece to generate a series of measurement periods Δt_M,

wherein the delaying comprises delaying the excitation of the ultrasonic sensor the dwell time T_d after a start of one of the measurement periods Δt_M.

20. The method of Claim 15, wherein the monitoring further comprises generating monitoring data by analyzing the reflected ultrasonic wave to determine at least one of (a) a size of the gap between the electrode and the workpiece and (b) a thickness of the workpiece.

21. The method of Claim 20, further comprising controlling at least one of the energizing and the feeding in response to the monitoring data.

10. APPENDIX OF EVIDENCE

None.

11. APPENDIX OF RELATED PROCEEDINGS

None.